جامعة محمد بوضياف- المسيلة -
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كلية التكنولوجيا
Faculty of Technology
قسم الهندسة الكهربائية و قسم الإلكترونيك
Department of Electrical Engineering and Department of Electronics
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University year: 2024/2025	السنة الجامعية: 2024 /2025
2nd year Electrical Engineering and Electronics	السنة الثانية هندسة كهربائية و إلكترونيك
Applied Work in Fundamentals of Electronics 1	أعمال تطبيقية في الالكرونيك الأساسية 1

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PW n°03: Thevenin's Theorem

Duration: 1^{h}30.

Date of the experiment: ………. /……../………….. .

Report prepared by:

Last Name	First Name	Group	S/Group	Final Note
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Instructions :

- **Internal laboratory regulations must be observed.**
- **You must wear a lab coat.**
- **Attendance is compulsory and will be monitored. Any unjustified absence or failure to hand in a report will result in a mark of 0/20.**
- **Have your assemblies checked before connecting the voltage source.**
- **It is strictly forbidden to move equipment from one station to another. In the event of a breakdown or faulty equipment, contact the teacher.**
- **The report must be written by a maximum of four students.**
- **The report must be handed in at the beginning of the next session.**
- **The report must include the following sections:**
  - **TP cover page.**
  - **The date of the practical session.**
  - **Last Name and first name of the main writer.**
  - **Last Names and first names of the WP participants.**
  - **Preparation and work in manuscript.**

Person in charge of practical work: Dr ROUABHI.R

<u>*PW n°03:* **Thevenin's Theorem**</u>

I. Objective of the Experiment

The purpose of this lab session is to model complex electrical circuits and simplify them into very basic circuits, allowing us to apply the fundamental laws of electricity without any complex calculations.

II. Theoretical Background

1. Thevenin's Theorem

An active two-terminal network that contains multiple voltage and current sources, as well as several impedances, can be simplified to a single voltage source (Thevenin voltage) in series with a unique impedance (Thevenin impedance). (See Figure 1)

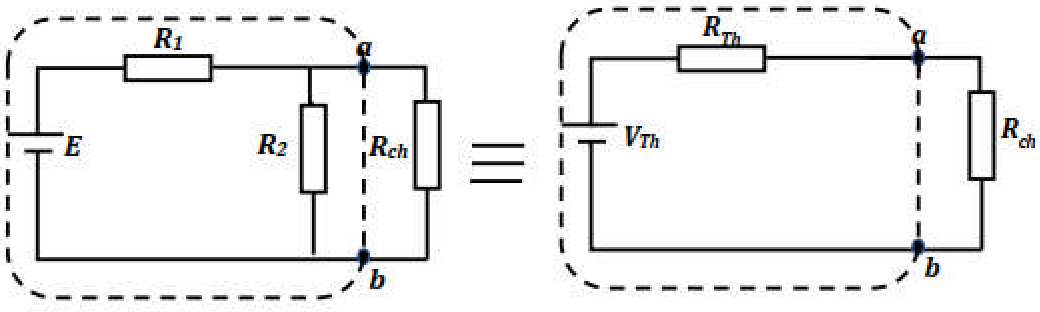

Figure.1: Thevenin Model.

1.1. Calculation Procedure

a. Thevenin Voltage the resulting current or voltage for the active source.

Disconnect the load resistance (or load impedance $\mathbf{R_{ch}}$ and measure the open-circuit voltage $\mathbf{V_{ab}}$. Therefore:

$$\mathbf{V_{ab} = V_{th}}.$$

b. Thevenin Resistance this With the load Rchstill disconnected, short-circuit all voltage sources and disconnect all current sources. Then, calculate the equivalent resistance of the circuit as seen between points **a** and **b** $\mathbf{R_{ab}}$ resulting in the Thevenin resistance:

$$\mathbf{R_{ab} = R_{th}}$$

Example:

Consider the following circuit:

To calculate the voltage Vthusing Thevenin's theorem, we need to determine the Thevenin equivalent circuit of the circuit above.

PW n°03: Thevenin's Theorem

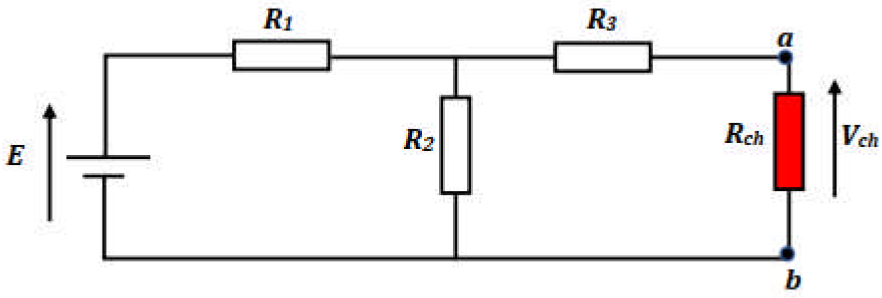

Figure.2.

a. Calculate V_{th}:

To calculate $\mathbf{V_{th}}$ we must disconnect the load Rchand measure the voltage between points a and b as follows:

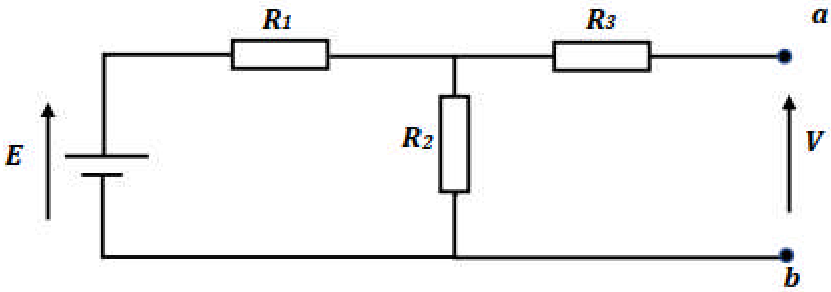

Figure.3.

This circuit is open between points a and b, so no current flows through the resistance R3 Consequently, the voltage between points a and b will be the same as the voltage across the resistance R2.By applying the voltage divider principle, we find that:

$$V = V_{th} = E\,\frac{R2}{R2 + R1}$$

b. Calculate R_{th}:

To calculate $\mathbf{R_{th}}$we must keep $\mathbf{R_{ch}}$ in place while short-circuiting the voltage source E:

The Thevenin resistance $\mathbf{R_{th}}$will correspond to the equivalent resistance of this circuit between points a and b:

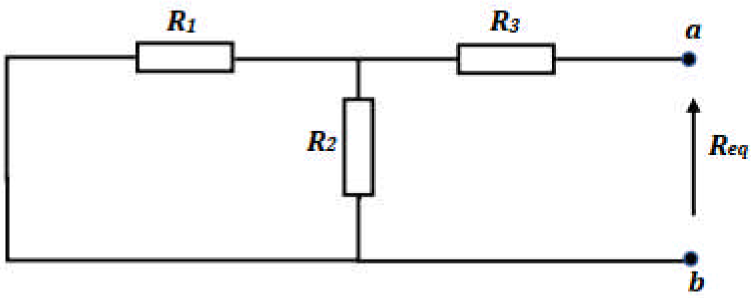

Figure.4.

$$Req = RTh = R3 + (R1 \backslash\backslash R2) = R3 + \frac{R1R2}{R2+R1}$$

Finally, the Thevenin equivalent circuit can be represented as follows:

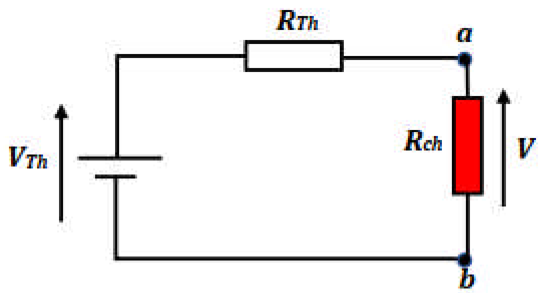

Figure.5.

Therefore, the voltage Vacross the resistance Rch can be expressed as follows: $V = V_{th}\frac{R_{ch}}{R_{ch}+R_{th}}$

3. Experimentation

3.1. Personal Work

a. Using Proteus, create the following circuit:

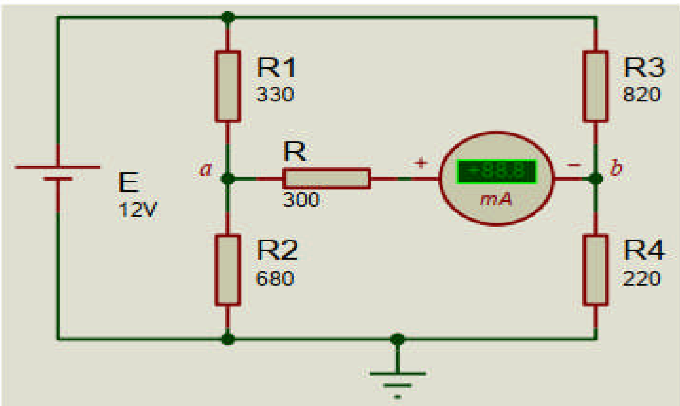

Figure.6.

b. Simulate the circuit and record the current flowing through the resistance R

c. Disconnect the resistance R andmeasure the voltage between points a and b (Vab=V_{th})as follows:

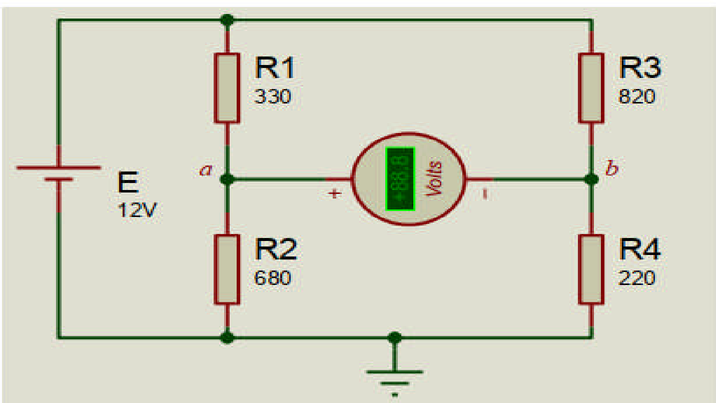

Figure.7.

d. Keep the resistance R disconnected, short-circuit the generator E and calculate the equivalent resistance between points a and b $\mathbf{R_{ab} = R_{th}}$ as follows:

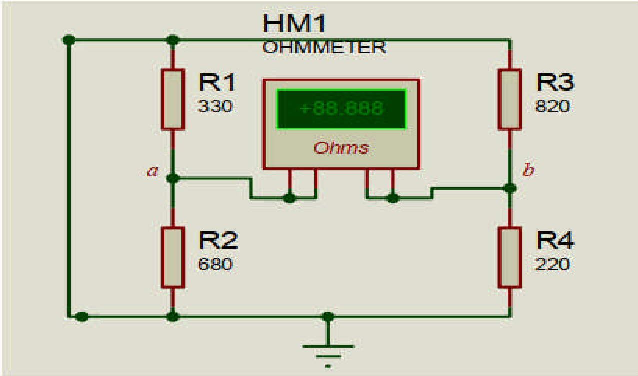

Figure.8.

e. Using the previously obtained measurements $\mathbf{V_{th}}$and $\mathbf{R_{th}}$**,** create the Thevenin circuit and calculate the current flowing through the resistance R as follows:

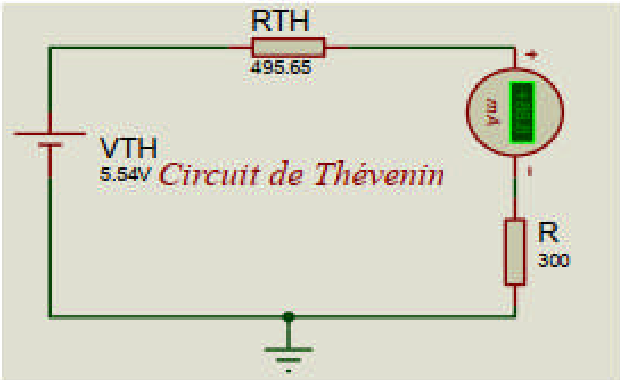

Figure.9.

f. Compare the current found in step e with the current found in step b. What can we conclude about Thevenin's theorem?

3.2. In-Person Work

Using the following circuit (Figure 2):

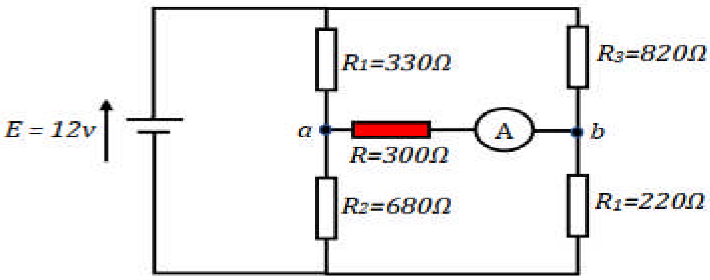

Figure.10.

a. Find the current I flowing through the resistance R using the mesh analysis method.

b. Determine the Thevenin equivalent circuit (V_{th},R_{th}) as seen by the resistance *R*.

c. Deduce the current *I* flowing through *R*

d. Set up the circuit as shown in Figure 2.

e. List the materials used.

f. Measure the current flowing through the resistance *R*.

g. Disconnect the resistance *R* and measure the open-circuit voltage V_{ab} ($V_{ab}= V_{th}$).

h. Short-circuit the voltage source E, keeping the resistance R disconnected. Using an ohmmeter, measure the resistance R_{th} between points **a** and **b** ($R_{ab} = R_{th}$)

i. Draw and construct the Thevenin equivalent circuit using V_{th} and R_{th}

j. Measure the current ***I*** flowing through the resistance ***R***.

k. Conclusion.